POLISHING APPARATUS AND METHOD OF BONDING AND REMOVING EXPENDABLE REPLACEMENT COMPONENTS THEREOF

BACKGROUND OF THE INVENTION

The present invention relates to a polishing apparatus having a top ring for holding a substrate and a polishing table having a polishing surface, wherein the substrate held by the top ring is brought into contact with the polishing surface, and in this state, the polishing table and the substrate are moved relative to each other to thereby polish the substrate. The present invention also relates to a method of bonding and removing expendable replacement components of the polishing apparatus.

Conventionally, a polishing apparatus for polishing substrates, e.g. semiconductor substrates, has a turntable with a polishing cloth bonded to the top surface thereof. A substrate held by a top ring or the like is brought into contact with the upper surface of the polishing cloth on the turntable. In this state, the turntable is rotated, and the top ring is also rotated, thereby polishing a surface to be polished of the substrate by a relative motion between the polishing cloth and the substrate.

To bond the polishing cloth to the top surface of the turntable in the polishing apparatus arranged as stated above, as shown in Fig. 1, an adhesive 12 is applied to either or both of the back of the polishing cloth 11 and the top surface of the turntable 10 (in the illustrated example, the adhesive 12 is applied to the back of the polishing cloth 11). As the adhesive 12, an adhesive

exhibiting high peel strength has heretofore been used to prevent the polishing cloth 11 from undesirably separating from the turntable 10 during the substrate polishing process.

For this reason, much human power and a special jig are required to remove the polishing cloth 11 from the turntable 10 at the time of replacement of the polishing cloth 11. Further, because much human power is needed to remove it, the polishing cloth 11 is damaged to a considerable extent when removed from the turntable 10. Therefore, if the polishing cloth 11 is removed before the time for replacement, it cannot be reused.

Although an adhesive that is unlikely to remain on the top surface of the turntable 10 after the polishing cloth 11 has been removed therefrom is used as the adhesive 12, a certain amount of adhesive is unavoidably left on the top surface of the turntable 10. Therefore, it has been invariably necessary to remove the remaining adhesive by wiping the top surface of the turntable 10 with alcohol every time the polishing cloth 11 is removed. The above-described operation of removing the polishing cloth 11 and the operation of wiping the top surface of the turntable 10 with alcohol to remove the remaining adhesive are time-consuming and difficult.

Similar problems are also experienced with the bonding and removal of a backing film, which is bonded to the substrate holding surface of the top ring of the polishing apparatus, and a pressure ring bonded to the top

ring and positioned at the outer peripheral portion of the substrate as held by the top ring.

SUMMARY OF THE INVENTION

The present invention was made in view of the above-described circumstances.

Accordingly, an object of the present invention is to provide a polishing apparatus wherein expendable replacement components such as a polishing cloth, a backing film and a pressure ring can be readily bonded to and removed from the polishing table and the top ring, and particularly, the expendable replacement components bonded to the polishing table and the top ring can be removed easily with minimal removal force, and also provide a method of bonding and removing such expendable replacement components of the polishing apparatus.

According to a first aspect thereof, the present invention provides a polishing apparatus having a top ring for holding a substrate and a polishing table having a polishing surface, wherein the substrate held by the top ring is brought into contact with the polishing surface, and in this state, the polishing table and the substrate are moved relative to each other to thereby polish the substrate. In the polishing apparatus, expendable replacement components to be bonded to the top ring and the polishing table are bonded to the top ring and the polishing table in such a manner that pieces of heat-sensitive adhesive (agent) or adhesive tape are interposed between the expendable replacement components on the one

hand and the top ring and the polishing table on the other. The heat-sensitive adhesive tape is switchable between a non-adhesive state and a adhesive state according to whether the temperature thereof is higher or lower than a predetermined set temperature.

As stated above, pieces of heat-sensitive adhesive tape are interposed between the expendable replacement components on the one hand and the top ring and the polishing table on the other to bond the expendable replacement components to the top ring and the polishing table. Because the heat-sensitive adhesive tape has the nature of switching between a non-adhesive (non-tacky) state and a adhesive state according to whether the temperature thereof is higher or lower than a predetermined set temperature, the expendable replacement components can be bonded and removed easily by heating or cooling the heat-sensitive adhesive tape above or below the set temperature. Particularly, when the heat-sensitive adhesive tape is made non-adhesive by heating or cooling, the expendable replacement components can be removed easily with minimal removal force. Further, because the removal force is minimized, the expendable replacement components can be removed without being damaged.

According to a second aspect of the present invention, the expendable replacement components of the above-described polishing apparatus are at least one selected from the group consisting of a polishing cloth bonded to the top surface of the polishing table, a backing film

bonded to the substrate holding surface of the top ring, and a pressure ring bonded to the top ring and positioned at the outer peripheral portion of the substrate as held by the top ring.

According to a third aspect thereof, the present invention provides an expendable replacement component bonding and removing method for use in a polishing apparatus. The polishing apparatus has a top ring for holding a substrate and a polishing table having a polishing surface. The substrate held by the top ring is brought into contact with the polishing surface, and in this state, the polishing table and the substrate are moved relative to each other to thereby polish the substrate. According to the method of the present invention, expendable replacement components to be bonded to the top ring and the polishing table are placed over the top ring and the polishing table in such a manner that pieces of heat-sensitive adhesive tape are interposed between the expendable replacement components on the one hand and the top ring and the polishing table on the other. The heat-sensitive adhesive tape is switchable between a non-adhesive state and a adhesive state according to whether the temperature thereof is higher or lower than a predetermined set temperature. Then, the heat-sensitive adhesive tape is heated above or cooled below the set temperature, thereby bonding the expendable replacement components to the top ring and the polishing table or removing the expendable replacement components bonded to

the top ring and the polishing table.

As stated above, pieces of heat-sensitive adhesive tape are interposed between the expendable replacement components on the one hand and the top ring and/or the polishing table on the other, and the heat-sensitive adhesive tape is switched between a non-adhesive state and a adhesive state by heating or cooling it above or below the set temperature. Therefore, it is easy to bond and remove the expendable replacement components. Particularly, when the heat-sensitive adhesive tape is made non-adhesive, the expendable replacement components can be removed easily with minimal removal force.

According to a fourth aspect of the present invention, the expendable replacement components in the method according to the third aspect of the present invention are bonded to the top ring and the polishing table or removed therefrom by using a jig for heating or cooling the pieces of heat-sensitive adhesive tape interposed between the expendable replacement components on the one hand and the top ring and/or the polishing table on the other.

The heat-sensitive adhesive tape can be readily made non-adhesive by using the jig for heating or cooling the heat-sensitive adhesive tape as stated above.

According to a fifth aspect of the present invention, the expendable replacement components in the method according to the third or fourth aspect of the present invention are at least one selected from the group consisting of a polishing cloth bonded to the top surface

of the polishing table, a backing film bonded to the substrate holding surface of the top ring, and a pressure ring bonded to the top ring and positioned at the outer peripheral portion of the substrate as held by the top ring.

According to a sixth aspect of the present invention, the method for polishing a substrate comprises the steps of: bonding a polishing cloth to a polishing table, polishing substrates with said polishing cloth, removing said polishing cloth, bonding another polishing cloth to said polishing table, and polishing substrates.

According to a seventh aspect of the present invention, the method for polishing a substrate comprises the steps of: bonding a first polishing cloth to a polishing table, polishing substrates with said first polishing cloth, removing said first polishing cloth, bonding a second polishing cloth to said polishing table, polishing substrates with said second polishing cloth, removing said second polishing cloth, and bonding said first polishing cloth to said polishing table.

The above and other objects, features and advantages of the present invention will become more apparent from the following description of the preferred embodiments thereof, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram schematically showing the arrangement of the turntable part of a conventional polishing apparatus.

Fig. 2 is a diagram schematically showing the

arrangement of the turntable part of a polishing apparatus according to the present invention.

Fig. 3 is a diagram showing a structural example of heat-sensitive adhesive tape.

Fig. 4 is a diagram schematically showing the arrangement of the turntable part of a polishing apparatus according to the present invention.

Fig. 5(a) is an external perspective view showing a structural example of a heating jig.

Fig. 5(b) is a sectional view of the heating jig shown in Fig. 5(a).

Fig. 6 is a diagram for describing a polishing cloth removing method according to the present invention.

Fig. 7 is a diagram for describing another polishing cloth removing method according to the present invention.

Fig. 8 is a diagram showing the relationship between the temperature and the peel strength of heat-sensitive adhesive tape.

Fig. 9 is a diagram schematically showing the arrangement of the top ring of a polishing apparatus according to the present invention.

Fig. 10 is a diagram showing a structural example of a jig usable for bonding and removing expendable components of the top ring according to the present invention.

(Explanation of Reference Numerals)

10: turntable

11: polishing cloth

12: pressure-sensitive adhesive

13: heat-sensitive adhesive tape

14: motor

15: heating/cooling system

16: rotary joint

20: heating jig

21: collar

22: heating wire

30: cooling jig

31: collar

32: refrigerant system

40: top ring

41: substrate holding plate

42: bolt

43: retainer ring

44: recess

45: pressure ring

46: backing film

47: mounting flange

48: shaft

49: driving shaft flange

50: ball bearing

51: space

52: communicating hole

60: plate-shaped heater

61: heating wire

62: plug socket

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention will be

described below with reference to the accompanying drawings. Fig. 2 is a diagram showing a structural example of the turntable part of a polishing apparatus according to the present invention. As illustrated in the figure, a polishing cloth 11 is bonded to the top surface of a turntable 10 with a piece of heat-sensitive adhesive tape 13 interposed between the polishing cloth 11 and the top surface of the turntable 10. It should be noted that reference numeral 14 denotes a motor for rotating the turntable 10 in the direction of the arrow A. As shown in Fig. 3, the heat-sensitive adhesive tape 13 comprises a PET (polyethylene terephthalate) film 13-1 and a heat-sensitive adhesive 13-2 applied to both sides of the PET film 13-1.

The heat-sensitive adhesive 13-2 on both sides of the PET film 13-1 constituting the heat-sensitive adhesive tape 13 is an adhesive known as "Intelimer" (registered trademark of Landec Corporation, U.S.A.). Intelimer is an adhesive that undergoes a reversible change from a crystalline state to an amorphous state according to changes in temperature of the outside. As shown in Fig. 8, one type of Intelimer functions as an ordinary adhesive (exhibiting high peel strength) below a preset temperature (switching temperature) Ts. However, above the set temperature Ts, the peel strength decreases, so that the Intelimer tape can be peeled off easily. There is another type of Intelimer that acts reversely to the above. That is, this type of Intelimer functions as an ordinary adhesive above a preset temperature Ts. However, below the

set temperature Ts, the peel strength decreases, so that the Intelimer tape can be peeled off easily. In this embodiment, Intelimer tape available from Nitta Corporation (Japan) is used as the heat-sensitive adhesive tape 13.

Thus, the polishing cloth 11 may be bonded to the top surface of the turntable 10 by using a heat-sensitive adhesive tape 13 in which the heat-sensitive adhesive 13-2 functions as an ordinary adhesive below the set temperature but decreases in peel strength above the set temperature. To bond the polishing cloth 11 to the top surface of the turntable 10 by using such a heat-sensitive adhesive tape 13, for example, the top surface of the turntable 10 is heated to a predetermined temperature higher than the set temperature, and the polishing cloth 11 is placed over the top surface of the turntable 10 with the heat-sensitive adhesive tape 13 interposed therebetween. In this case, because the top surface temperature of the turntable 10 is higher than the set temperature, the peel strength of the heat-sensitive adhesive 13-2 is low, which facilitates the alignment of the polishing cloth 11 and the heat-sensitive adhesive tape 13 on the top surface of the turntable 10. In this state, the turntable 10 is cooled down to a predetermined temperature below the set temperature (e.g. to a temperature lower than the set temperature by 10°C or more), and the upper surface of the polishing cloth 11 is pressed with a rubber roller or the like. Thus, the polishing cloth 11 can be bonded to the top surface of the turntable 10 with the heat-sensitive adhesive tape 13

interposed therebetween.

The heat-sensitive adhesive 13-2 can be kept in a state where the peel strength is high by maintaining the temperature of the turntable 10 in use at a level lower than the set temperature by a predetermined temperature. Therefore, there is no possibility of the polishing cloth 11 undesirably separating from the turntable 10. To remove the polishing cloth 11 from the turntable 10, the turntable 10 is heated to a predetermined temperature above the set temperature (e.g. to a temperature higher than the set temperature by 10°C or more). Consequently, the peel strength of the heat-sensitive adhesive 13-2 decreases. Therefore, the polishing cloth 11 can be readily removed from the turntable 10. In a case where the heat-sensitive adhesive 13-2 is adhesive above a set temperature but non-adhesive below the set temperature, the temperature of the turntable 10 in use is maintained at a predetermined temperature above the set temperature. To remove the polishing cloth 11, the turntable 10 is cooled down to a predetermined temperature below the set temperature.

Fig. 4 is a diagram showing a structural example of the turntable part of a polishing apparatus according to the present invention. As illustrated in the figure, a heating/cooling system 15 for heating or cooling is provided in the turntable 10 through a rotary joint 16. The heating/cooling system 15 is supplied with a heating heat transfer medium Q_1 or a cooling refrigerant Q_2 from a heat transfer medium source or a refrigerant source (not

shown). Thus, the heating heat transfer medium Q_1 or the cooling refrigerant Q_2 can be circulated through the heating/cooling system 15.

In the case of using the heat-sensitive adhesive tape 13 in which the heat-sensitive adhesive 13-2 is adhesive above a set temperature but non-adhesive below the set temperature, when the polishing cloth 11 is to be bonded, the cooling refrigerant Q_2 is circulated through the heating/cooling system 15 to cool and maintain the top surface of the turntable 10 at a predetermined temperature below the set temperature. In this state, the polishing cloth 11 is placed over the top surface of the turntable 10 with the heat-sensitive adhesive tape 13 interposed therebetween. In this state, the peel strength of the heat-sensitive adhesive 13-2 is low. Therefore, it is easy to perform alignment of the heat-sensitive adhesive tape 13 and the polishing cloth 11. Upon completion of the alignment, the circulation of the cooling refrigerant Q_2 is stopped to allow the turntable 10 to rise in temperature. Alternatively, the heating heat transfer medium Q_1 is circulated through the heating/cooling system 15 to raise the temperature of the turntable 10 positively. By doing so, the temperature of the turntable 10 is raised to a predetermined level above the set temperature. This allows the heat-sensitive adhesive 13-2 to exhibit adhesiveness (tackiness). Therefore, the polishing cloth 11 can be bonded by pressing the upper surface of the polishing cloth 11 with a rubber roller or the like.

By setting the set temperature of the heat-sensitive adhesive 13-2 at a predetermined temperature lower than the working temperature of the turntable 10, the polishing cloth 11 is kept bonded to the top surface of the turntable 10 by the strong adhesiveness of the heat-sensitive adhesive 13-2 during the substrate polishing process. Therefore, there is no possibility that the polishing cloth 11 may undesirably separate from the turntable 10. When the polishing cloth 11 is to be temporarily removed and bonded again or to be replaced with another polishing cloth 11, the cooling refrigerant Q_2 is circulated through the heating/cooling system 15 to cool the top surface of the turntable 10 to a predetermined temperature below the set temperature. Consequently, the heat-sensitive adhesive 13-2 loses its adhesiveness. Therefore, it becomes possible to remove the polishing cloth 11 easily.

In the case of using the heat-sensitive adhesive tape 13 in which the heat-sensitive adhesive 13-2 is non-adhesive above a set temperature but adhesive below the set temperature, when the polishing cloth 11 is to be bonded, the heating heat transfer medium Q_1 is circulated through the heating/cooling system 15 to heat the top surface of the turntable 10 to a predetermined temperature above the set temperature. In this state, the polishing cloth 11 is placed over the top surface of the turntable 10 with the heat-sensitive adhesive tape 13 interposed therebetween. In this state, the heat-sensitive adhesive 13-2 is non-adhesive. Therefore, it is easy to perform alignment of

the heat-sensitive adhesive tape 13 and the polishing cloth 11. Upon completion of the alignment, the circulation of the heating heat transfer medium Q_1 is stopped to allow the turntable 10 to lower in temperature. Alternatively, the cooling refrigerant Q_2 is circulated through the heating/cooling system 15 to lower the temperature of the turntable 10 positively. By doing so, the temperature of the turntable 10 is lowered to a predetermined level below the set temperature. This allows the heat-sensitive adhesive 13-2 to exhibit adhesiveness. Therefore, the polishing cloth 11 can be bonded by pressing the upper surface of the polishing cloth 11 with a rubber roller or the like.

By setting the set temperature of the heat-sensitive adhesive 13-2 at a predetermined temperature higher than the working temperature of the turntable 10, the polishing cloth 11 is kept bonded to the top surface of the turntable 10 by the strong adhesiveness of the heat-sensitive adhesive 13-2 during the substrate polishing process. Therefore, there is no possibility that the polishing cloth 11 may undesirably separate from the turntable 10. When the polishing cloth 11 is to be temporarily removed and bonded again or replaced with another polishing cloth 11, the heating heat transfer medium Q_1 is circulated through the heating/cooling system 15 to heat the top surface of the turntable 10 to a predetermined temperature above the set temperature. Consequently, the peel strength of the heat-sensitive adhesive 13-2 decreases. Therefore, it

becomes possible to remove the polishing cloth 11 easily.

The heating heat transfer medium Q_1 or the cooling refrigerant Q_2 may be supplied to the heating/cooling system 15 during the operation of the turntable 10 to maintain the top surface of the turntable 10 at a temperature above or below the set temperature of the heat-sensitive adhesive 13-2 at which the heat-sensitive adhesive 13-2 exhibits strong adhesiveness. During the suspension of the operation, the adhesiveness of the heat-sensitive adhesive 13-2 may be reduced.

In the example shown in Fig. 4, the heating/cooling system 15 for heating or cooling is provided in the turntable 10. It should be noted, however, that the polishing cloth 11 bonded to the turntable 10 can also be removed by using a heating jig 20 as shown in Figs. 5(a) and 5(b). That is, the heating jig 20 is in the shape of a disk having a geometry capable of covering the turntable 10. The disk-shaped heating jig 20 has a collar 21 formed around the periphery thereof. The heating jig 20 has a heating wire 22 buried therein. The whole heating jig 20 can be heated by supplying a heating current to the heating wire 22 from an AC or DC power supply. It should be noted that Fig. 5(a) is a perspective view showing the whole heating jig 20, and Fig. 5(b) is a sectional view of the heating jig 20.

The process of removing the polishing cloth 11 from the top surface of the turntable 10 by using the heating jig 20 shown in Figs. 5(a) and 5(b) will be described below

with reference to Fig. 6. It is assumed that the heat-sensitive adhesive tape 13 used in this example has a heat-sensitive adhesive 13-2 that is non-adhesive above a set temperature but adhesive below the set temperature, and that the set temperature is a predetermined temperature above the working temperature of the turntable 10. First, the polishing cloth 11 is bonded to the top surface of the turntable 10 at the working temperature with the heat-sensitive adhesive tape 13 interposed therebetween, and used for polishing substrates. When the polishing cloth 11 is to be temporarily removed and bonded again or to be replaced with another polishing cloth 11, the heating jig 20 is put over the polishing cloth 11 on the turntable 10, and the heating wire 22 is supplied with a heating current. Thus, the heating jig 20 heats up. Consequently, the heat-sensitive adhesive 13-2 of the heat-sensitive adhesive tape 13 loses its adhesiveness to become non-adhesive. In this state, the heating jig 20 is taken off, and the polishing cloth 11 is removed from the turntable 10. Thus, the polishing cloth 11 can be removed from the turntable 10 easily with minimal removal force.

In the case of using the heat-sensitive adhesive tape 13 in which the heat-sensitive adhesive 13-2 is non-adhesive at a predetermined set temperature below the working temperature of the turntable 10 but adhesive above the set temperature, the polishing cloth 11 is bonded to the top surface of the turntable 10 at the working temperature with the heat-sensitive adhesive tape 13

interposed therebetween, and used for polishing substrates. When the polishing cloth 11 is to be temporarily removed and bonded again or to be replaced with another polishing cloth 11, a cooling jig 30 is put over the polishing cloth 11, as shown in Fig. 7 by way of example. The cooling jig 30 has a refrigerant system 32 buried therein for passing a cooling refrigerant Q_3 [the external geometry of the cooling jig 30 is almost the same as that of the heating jig 20 shown in Figs. 5(a) and 5(b); the disk-shaped cooling jig 30 has a collar 31 formed around the periphery thereof]. Then, the refrigerant system 32 is supplied with the cooling refrigerant Q_3. Thus, the heat-sensitive adhesive 13-2 of the heat-sensitive adhesive tape 13 is cooled down to a predetermined temperature below the set temperature and hence loses its adhesiveness to become non-adhesive. In this state, the cooling jig 30 is taken off, and the polishing cloth 11 is removed from the turntable 10. Thus, the polishing cloth 11 can be removed from the turntable 10 easily with minimal removal force.

As has been stated above, the polishing cloth 11 is bonded to the top surface of the turntable 10 with the heat-sensitive adhesive tape 13 interposed therebetween. Therefore, the polishing cloth 11 can be bonded and removed easily by controlling the temperature of the turntable 10. The use of the heating jig 20 or the cooling jig 30 allows the bonded polishing cloth 11 to be removed from the turntable 10 easily with minimal removal force. Accordingly, the replacement operation for the polishing

cloth 11 is improved to a considerable extent. Consequently, it becomes unnecessary to perform the conventional troublesome removing operation using a special jig. In addition, it becomes possible to remove the polishing cloth 11 temporarily before the time for replacement and to reuse it later. For example, when the user wants to perform another polishing process in the course of use of the polishing cloth 11, it is possible to remove the polishing cloth 11 temporarily, bond another kind of polishing cloth 11, remove this polishing cloth 11 after the desired polishing process, and bond the first-removed polishing cloth 11 again to perform the previous polishing process.

The heat-sensitive adhesive tape 13 can be switched between the adhesive state and the non-adhesive state by selectively heating and cooling the turntable 10 by the use of the temperature control function of cooling water in the turntable 10. However, in a case where such a switching operation cannot readily be implemented owing to some problems with the chiller equipment in the plant, the use of the heating jig 20 for heating the polishing cloth 11 allows the heat-sensitive adhesive tape 13 to be readily switched between the adhesive state and the non-adhesive state.

Although in the foregoing embodiment the present invention has been described with regard to the polishing apparatus using the turntable 10, by way of example, the present invention is not necessarily limited to the

polishing apparatus using the turntable 10. The present invention is widely applicable to any polishing apparatus having a table with a polishing cloth bonded thereto, wherein an object to be polished is brought into contact with the surface of the polishing cloth on the table and polished by a relative motion between the polishing cloth and the object.

In the foregoing embodiment, the polishing cloth 11 is bonded to the top surface of the turntable 10 of the polishing apparatus with the heat-sensitive adhesive tape 13 interposed between the top surface of the turntable 10 and the polishing cloth 11. However, the present invention is not necessarily limited to the described embodiment. For example, the present invention is also applicable to a backing film and a pressure ring that are bonded to a top ring. Fig. 9 is a sectional view showing a structural example of a top ring according to the present invention.

As shown in Fig. 9, the top ring 40 according to the present invention has a substrate holding plate 41 and a retainer ring 43 detachably secured to the outer peripheral portion of the substrate holding plate 41 with bolts 42. A recess 44 for accommodating a substrate Wf is formed by the lower surface (substrate holding surface) of the substrate holding plate 41 and the retainer ring 43. A pressure ring 45 is vertically movably provided around the substrate holding plate 41. The substrate holding plate 41 has a backing film 46 bonded to the lower surface thereof. Further, the substrate holding plate 41 has a mounting

flange 47 secured to the center of the upper surface thereof. The mounting flange 47 has a concave spherical surface 47a.

A shaft 48 is disposed above the mounting flange 47. The shaft 48 has a driving shaft flange 49 secured to the lower end thereof. The driving shaft flange 49 has a concave spherical surface 49a. A ball bearing 50 is interposed between the concave spherical surface 47a and the concave spherical surface 49a. A space 51 is formed between the substrate holding plate 41 and the mounting flange 47. The space 51 can be selectively supplied with a vacuum or a fluid such as pressurized air or water. The substrate holding plate 41 has communicating holes 52 opening on the lower surface thereof. The communicating holes 52 are in communication with the space 51. The backing film 46 also has through-holes formed at respective positions facing the communicating holes 52. Thus, the upper surface of the substrate Wf can be held by a vacuum to the lower surface of the substrate holding plate 41 through the backing film 46. It is also possible to supply a fluid such as a liquid or pressurized air to the upper surface of the substrate Wf.

The pressure ring 45 comprises a first pressure ring member 45a located at the lowermost position and made of alumina ceramics, and second and third pressure ring members 45b and 45c disposed above the first pressure ring member 45a and made of a stainless steel. The second and third pressure ring members 45b and 45c are connected to

each other with bolts (not shown). The first pressure ring member 45a is bonded to the second pressure ring member 45b. The lower end of the first pressure ring member 45a forms a pressure surface 45f for pressing the polishing cloth 11 (see Fig. 2) bonded to the top surface of the turntable 10.

In operation, a substrate Wf is held by suction to the lower surface of the backing film 46 bonded to the lower surface of the substrate holding plate 41 of the top ring 40 arranged as stated above. Then, the substrate Wf is pressed against the upper surface of the polishing cloth 11 on the turntable 10 shown in Fig. 2. In this state, the substrate Wf is polished by a relative motion between the substrate Wf and the polishing cloth 11 caused by the rotation of the top ring 40 about the shaft 48 and the rotation of the turntable 10. The polishing operation causes the first pressure ring member 45a of the pressure ring 45 to wear out. Therefore, the first pressure ring member 45a needs to be replaced when it has worn out to a predetermined extent. The backing film 46 also wears out in the course of polishing a large number of substrates Wf. Therefore, the backing film 46 also needs to be replaced at a predetermined timing.

In this embodiment, the above-described heat-sensitive adhesive tape (not shown in Fig. 9) is used for the first pressure ring member 45a and the backing film 46. More specifically, a piece of heat-sensitive adhesive tape is interposed between the first pressure ring member 45a and the second pressure ring member 45b of the pressure

ring 45 to bond the first pressure ring member 45a to the lower surface of the second pressure ring member 45b. Further, a piece of heat-sensitive adhesive tape is interposed between the backing film 46 and the substrate holding plate 41 to bond the backing film 46 to the lower surface of the substrate holding plate 41.

By using the heat-sensitive adhesive tape to bond the first pressure ring member 45a to the second pressure ring member 45b and also using the heat-sensitive adhesive tape to bond the backing film 46 to the lower surface of the substrate holding plate 41, the first pressure ring member 45a and the backing film 46 can be bonded and removed extremely easily by the temperature control of the heat-sensitive adhesive tape as in the case of the above.

The bonding and removing operation may be carried out by using a plate-shaped heater 60 having a heating wire 61 as shown in Fig. 10 by way of example. That is, the plate-shaped heater 60 is brought into contact with the backing film 46 or the first pressure ring member 45a, and the heating wire 61 is supplied with a heating current through a plug socket 62 to heat the backing film 46 or the first pressure ring member 45a, thereby allowing the backing film 46 or the first pressure ring member 45a to be bonded or removed easily.

It should be noted that the structural example of the top ring is not necessarily limited to the above. For example, the present invention is similarly applicable to a top ring employing a retainer ring directly retaining the

side surface of a substrate.

Although in the foregoing embodiments the present invention has been described with regard to the operation of bonding and removing the backing film 46, the first pressure ring member 45a and the polishing cloth 11, by way of example, it should be noted that the present invention is not necessarily limited thereto but may be used for bonding and removing various expendable replacement components to be bonded to the top ring or the polishing table of the polishing apparatus.

As has been stated above, the present invention provides various advantageous effects as stated below.

According to the first and second aspects of the present invention, pieces of heat-sensitive adhesive tape are interposed between expendable replacement components such as a backing film, a pressure ring and a polishing cloth on the one hand and the top ring and the polishing table on the other to bond the expendable replacement components to the top ring and the polishing table. The heat-sensitive adhesive tape has the nature of switching between a non-adhesive state and a adhesive state according to whether the temperature thereof is higher or lower than a predetermined set temperature. Therefore, the expendable replacement components can be bonded and removed easily by heating or cooling the heat-sensitive adhesive tape above or below the set temperature. Particularly, when the heat-sensitive adhesive tape is made non-adhesive by heating or cooling, the expendable replacement components can be

removed easily with minimal removal force. Further, because the removal force is minimized, the expendable replacement components can be removed without being damaged. Accordingly, it becomes possible to remove the expendable replacement components temporarily before the time for replacement and to reuse them later.

According to the third to fifth aspects of the present invention, pieces of heat-sensitive adhesive tape are interposed between expendable replacement components such as a backing film, a pressure ring and a polishing cloth on the one hand and the top ring and the polishing table on the other, and the heat-sensitive adhesive tape is switched between a non-adhesive state and a adhesive state by heating or cooling it above or below a set temperature. Therefore, it is easy to bond and remove the expendable replacement components. Particularly, when the heat-sensitive adhesive tape is made non-adhesive, the expendable replacement components can be removed easily with minimal removal force. Accordingly, it is possible to obtain advantageous effects similar to those obtained by the arrangement according to the first and second aspects of the present invention.

According to the fourth aspect of the present invention, the heat-sensitive adhesive tape can be made non-adhesive easily by using a jig for heating or cooling the heat-sensitive adhesive tape.

It should be noted that the present invention is not necessarily limited to the foregoing embodiments but can be

modified in a variety of ways without departing from the gist of the present invention.